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METHOD OF MAKING POROUS METAL ARTICLES

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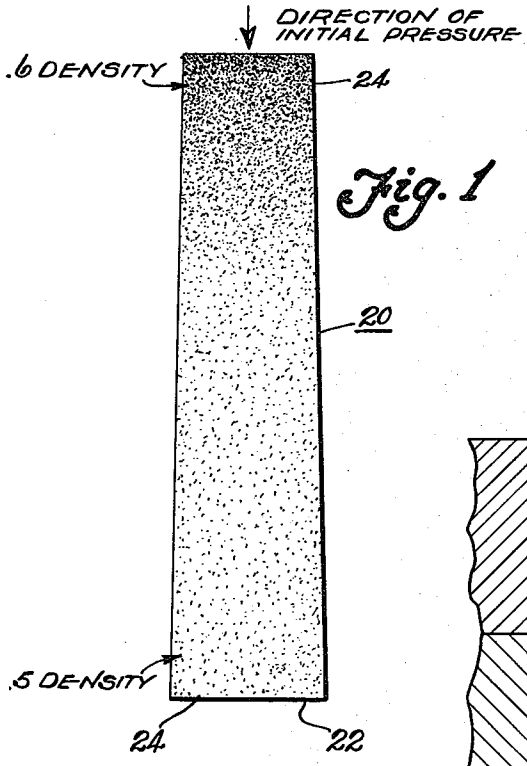


Fig. 1

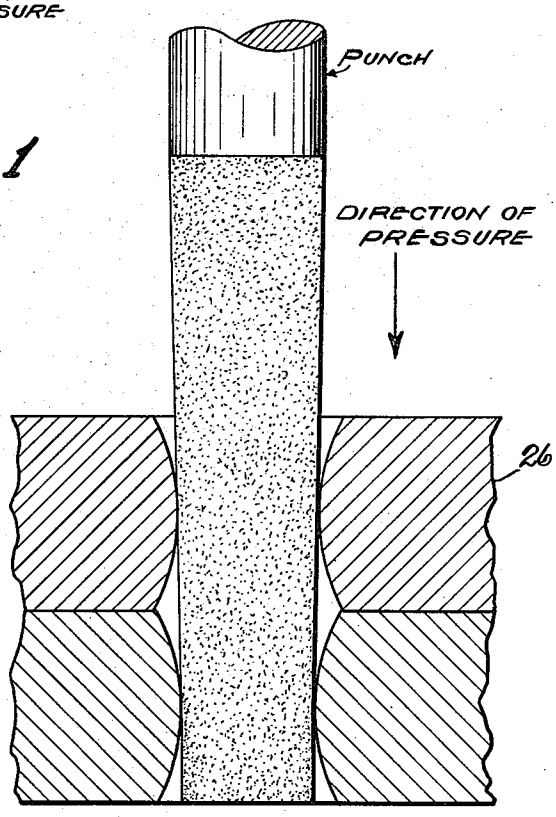


Fig. 2

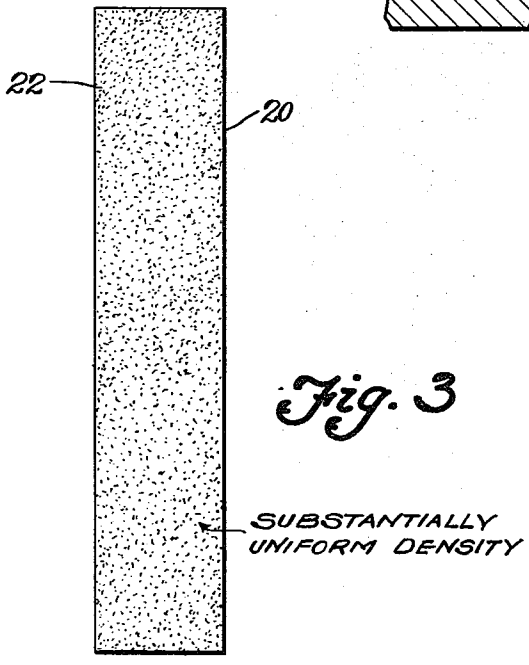


Fig. 3

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METHOD OF MAKING POROUS METAL ARTICLES

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4 Claims. (Cl. 29—148)

This invention relates to a method for making porous metal articles and is particularly concerned with a method for making porous metal articles which have substantially uniform density throughout.

One of the past problems in the manufacture of elongated porous metal articles has been the maintenance of a uniform density throughout the elongated article.

It is therefore an object of the invention to provide a method for manufacturing an elongated porous metal article wherein the entire article is of substantially uniform density.

In carrying out the above object it is a further object to briquette the elongated article, such as a rod, tube or the like in a frusto-conical shape wherein the diameter at one end of the article is substantially the diameter desired and the diameter at the other end of the article is greater than the diameter desired and then size the article after sintering for causing the density of the article to become uniform through the crowding of metal at the low density portion thereof.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the invention is clearly shown.

In the drawing:

Fig. 1 shows a briquette made in accordance with the present invention prior to sizing.

Fig. 2 is a fragmentary view showing the briquette being forced through a sizing die.

Fig. 3 shows the article in the finished form.

In the manufacture of porous metal articles the standard procedure for briquetting such articles consists in filling a die of substantially the shape desired with metal powder and then briquetting the metal powder by means of a punch operating from one end of the die. This forces the metal powder particles into close association with one another, thereby causing the article upon ejection from the die to be of a self-sustaining shape which shape can be sintered under standard procedure for forming a porous metal article. This article is generally sized to exact size after sintering. In this latter operation the article is forced through a die and uniformly compressed over the entire surface thereof. In the manufacture of elongated articles from porous metal it has been found that when briquetting the powder in the die that the powder adjacent the punch was briquetted to a greater extent than at the other end of the die. This is probably caused by entrapped air, friction on the walls of the die, etc. This non-uniformity of the density throughout the length of the article is not great in articles which are relatively short. However, when manufacturing articles of substantial length it has been found that the variation in density is considerable and it is apparent that as the density varies the strength likewise varies. Furthermore, the oil flow through the article is also caused to be variable by the variation in density since the porosity of the article varies. Numerous attempts have been made to make articles of elongated shapes wherein the density from one end to the other is maintained substantially constant. One of these attempts has been partially successful and consists of the use of a movable lower punch in the die together with a movable upper punch wherein both punches operate simultaneously and in opposite directions to compress the powder therebetween. In this instance articles of substantial uniform density may be made in greater length than by the single pressure method hereinbefore described, but again, if the article is of substantial length, for example, in the ratio of 3 or 4 to 1 with respect to the diameter, the non-uniformity in density occurs toward the center portion of the article and the end portions are found to be of more or less uniform density.

I have found that by shaping the briquetting die for a different contour than the article ultimately desired and then by sizing the article to the shape ultimately desired it is possible to use a single punch die and have substantially uniform density articles after sizing even though the ratio of length to breadth was in the order of 6 to 1 or better. For illustrative purposes only an example will be given in the form of a rod 20 5" long with a 1" diameter. Such a rod would be extremely difficult to make by the usual procedures and if it were made by normal single punch methods it would be found that the density at the end at which the pressure was applied would be considerably more than the density at the other end. In order to compensate for the variation in density, I propose to make this rod 20 in frusto-conical shape wherein the diameter 22 at the low density end is increased in the same proportion with respect to the original diameter as the variation in the density in the two ends. For example, if the density at the high density end 24 is .6 and the density at the low density end is .5 when the article is made by the conventional one punch procedure then the die for carrying my new method would have a diameter of one inch at the upper end and a diameter of 1.2" at the other end thereof. In this instance after the

rod has been briquetted it would be removed from the bottom end of the die to make use of the taper thereon. Next, this rod would be sintered by conventional methods in a controlled atmosphere into a strong porous metal article. It would next be pressed lengthwise through a button die **26** having a one inch diameter. As the rod **20** was pressed therethrough it would be progressively reduced in diameter which will progressively increase the density from the high density end to the low density end so that the density would be constant throughout. In cases where extreme sizing is required there may be some slight change in length but this can be allowed for in the original briquetting operation if necessary although in most cases where a slight variation in density occurs the length is substantially constant.

All manner of shapes having annular cross sections, round shapes have regular cross sections such as pentagonal; rectangular shapes may be made by the same method with complete success. Obviously the use of metal such as bronze, sponge iron and other ductile materials is preferred in the manufacture of articles of this type since the sizing of articles requires compressibility or ductility in the part.

In cases where hardened materials, such as steel parts, are operated on by the pressing method there is a tendency for breakage to occur between bonds. However, this may be rectified by a second sintering operation if necessary. In the case of ductile metals however sizing them may be easily accomplished without any breakage of the bonds and therefore the second sintering operation is not required as a rule when operations are carried out on sponge iron, bronze or brass parts.

Specific briquetting machines have not been discussed since these are well known in the art. A press of the type usually used is shown in Davis No. 2,127,994, wherein a small tubular bushing is being made. Another patent which shows a press of the general type described may be noted in the Short Patent No. 1,839,056. Likewise, briquetting procedures are well known in the art and for more detailed information reference may be had to the Lenel Patent No. 2,191,936, which gives considerable information on the sintering of iron, all of the aforementioned patents being assigned to the assignee of the present invention.

From the foregoing it is apparent that this method while primarily directed to a means for providing articles from porous metal having substantially uniform density may likewise be utilized to make articles of controlled density. That is to say, if it is desired to make an article having a higher density at one end than at the other end thereof, wherein the density at either end is predetermined or controlled, it is possible by forming the article to a predetermined shape and subsequently sizing the same to increase the density at one end thereof to a density greater than the density at the other end. This difference in density should not be confused with unequal densities apparent when articles are conventionally briquetted since the present variation in density is predetermined and controlled by the briquetted shape of the article. Similarly, it is possible to form an article having a higher density at the middle thereof than at either end. This may be done by briquetting in a two-part die wherein the middle section is of a greater dimension than either of the ends thereof. Then by properly sizing the article, it will be apparent that the middle section, when compressed to the same dimension as the ends, will be increased in density to a point where the density at the middle is greater than the density at either end. Manifestly, any variations in controlling the density of the article as suggested herein, come within the scope of my invention.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a method of making porous metal articles of elongated shape and substantial uniform density throughout the steps comprising: briquetting the article in a frusto-conical shape having a length in the order of three times the diameter wherein the larger diameter portion is adjacent the end of the article having the lowest density, sintering the articles so briquetted to form a strong porous article and then sizing the article through a die of constant diameter for causing the entire article to have a constant diameter throughout the length thereof whereby the density is likewise substantially constant throughout the length.

2. In a method of making porous metal articles having a greater length than breadth of a substantially uniform density throughout the steps comprising; providing a die having a greater dimension at the bottom thereof than at the top, filling the die with metal powder and briquetting the metal powder therein to form an article of substantially frusto-conical shape having a length in the order of three times the diameter wherein the larger dimension portion is adjacent the bottom of the die and wherein said larger dimension portion is of lower density due to the direction of pressure application during the briquetting step, removing the article so formed from the die through the larger dimension end thereof, sintering the article under suitable conditions of time, temperature and atmosphere for forming a strong porous article, and then sizing the article through a die of constant dimension substantially equal to the smaller dimensioned end of the article for causing the entire article to have a constant diameter whereby the density of the article is substantially constant due to compression of the larger dimension portion thereof while passing through the die.

3. In the method of controlling the porosity of porous metal articles the step comprising; briquetting metal powder in a die having one portion thereof of larger diameter than the remainder of the die to form an article wherein the length is at least three times the diameter, sintering the article so briquetted under suitable conditions of time, temperature and atmosphere into a strong porous article, and then sizing the sintered article through a constant diameter die having a diameter substantially equal to the smallest diameter on the porous metal article whereby the porosity of the article is controlled due to compression of the larger diameter portion thereof as predetermined by the original shape of the briquetted die.

4. In a method of making porous metal articles of elongated shape and of substantially uniform density throughout, the steps comprising; briquetting metal powder into an article of frusto-conical shape to form an article wherein the length is at least three times the diameter wherein the larger diameter portion is adjacent

the end of the article having the lowest density as caused by compression of the metal powder from the opposite end thereof, sintering the article so briquetted under suitable conditions of time, temperature and atmosphere to form a strong porous metal article, and then forcing the porous metal article through a die of constant diameter substantially equal to the smallest diameter of the article for causing the entire article to be sized to a constant diameter throughout its length, the diameter of the article being so graduated that after said sizing step the density at any portion of the article is substantially constant.

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